

Article

Spatial-Temporal Variation Characteristics and Obstacle Factors of Resilience in Border Cities of Northeast China

Kaiping Jiang ¹, Kaichao Li ², Nan Cong ^{3,*}, Siyu Wu ^{4,5} and Fei Peng ^{4,5,*}

¹ School of Geographical Science, Liaoning Normal University, Dalian 116029, China

² School of Economics and Management, Hezhou University, Hezhou 542899, China

³ Lhasa Plateau Ecosystem Research Station, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

⁴ Center for Studies of Marine Economy and Sustainable Development, Liaoning Normal University, Dalian 116029, China

⁵ Institute of Marine Sustainable Development, Liaoning Normal University, Dalian 116029, China

* Correspondence: congnan@igsnnr.ac.cn (N.C.); feipeng@lnnu.edu.cn (F.P.)

Abstract: The study of border resilience is an effective means to analyze the development status of border cities. This study constructs a border city resilience assessment framework, measures the urban resilience level of 13 prefecture-level administrative regions in China's northeastern border region from 2010 to 2019, reveals their temporal and spatial differentiation characteristics, analyzes the main obstacles, and proposes development strategies. This study reveals the following: (1) The overall resilience of the northeast border cities is at a medium level, and differences between regions and cities are large. (2) The resilience of the northeast border cities increased rapidly between 2010 and 2015, especially in the western area; the improvement effect was poor between 2015 and 2019, and except for the increased resilience of individual cities in the eastern area, the development of other cities was slow and some even declined. (3) At the city scale, the development potential, economic structure, residents' security, and environmental governance capabilities are the main factors restricting improvement in the basic resilience of the northeast border cities. Insufficient national policy support and the poor development of neighboring countries have become obstacles to cities' exclusive resilience.

Keywords: Northeast China; Chinese border; border city; regional resilience; development difference



Citation: Jiang, K.; Li, K.; Cong, N.; Wu, S.; Peng, F. Spatial-Temporal Variation Characteristics and Obstacle Factors of Resilience in Border Cities of Northeast China. *Land* **2023**, *12*, 958. <https://doi.org/10.3390/land12050958>

Academic Editors: Jun Yang, Bing Xue, Zhi Qiao, Wei Sun, Xiangming Xiao, Jianhong (Cecilia) Xia and Heiko Thomas

Received: 16 March 2023

Revised: 19 April 2023

Accepted: 20 April 2023

Published: 26 April 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Cities are the core and foundation of the development of border areas. Against the backdrop of deepening reform, opening up and the “Belt and Road” initiative, border cities have become the frontiers of economic opening and rely on cross-border trade at ports and its important role at the regional and national levels [1]. With the all-round improvement in the ecological environment and infrastructure of the domestic border areas, border tourism has gradually emerged, and border cities are responsible for being bases for both opening up and domestic cultural tourism centers [2]. Thus, the development of border cities has received extensive attention [3,4]. However, owing to the disadvantage of internal geographical location and the influence of the external geographical environment, the development level of border cities still lags far behind that of other cities, showing higher vulnerability when dealing with external threats [5]. In recent years, the coronavirus disease (COVID-19) pandemic has spread worldwide, and border cities have faced the dual challenges of epidemic prevention, control, and economic development [6]. Improving the level of urban resilience and effectively managing its impact will become key issues in research on China's border cities.

The concept of “resilience” originated from the study of physics, and originally meant “the ability of an object to return to its original state”. In 1970, Holling introduced it into the

field of ecology and used it as a reference in psychological research, after which the fields of engineering technology and socioeconomics successively introduced resilience [7]. After the Local Governments for Sustainability (or simply ICLEI) formally introduced the idea of resilience to urban issues in 2002, several scholars and institutions at home and abroad have researched urban resilience and subsequently proposed the concept of building a globally resilient city [8]. At present, the related research on urban resilience closely combines the “human–land” relationship regional system with the “economic–society–ecological” coupling system [9]; this has become an important way to explore and solve the problem of urban sustainable development in terms of regional economics and geography. In terms of research content, foreign scholars’ research on urban resilience mainly focuses on the conceptual definition, element integration, and evaluation methods [10]. In recent years, collaborative governance and community control have emerged as new perspectives in resilience research in the West [11,12]. Research on urban resilience in China has focused on defining the connotations of the concept [13], conducting resilience measurements and evaluations [14], and analyzing evolution trends [15]. Most research methods are based on the construction of an evaluation system that is centered on the basic components of resilient cities using empirical methods [15–17]. Specifically, it includes a comprehensive index method, resilience network method, function model method, and layer-stacking method in order to analyze the degree of urban resilience comprehensively and quantitatively [18]. Based on this, urban resilience-related research focuses on typical geographic research areas (e.g., the Yangtze River Delta region and cities in the middle reaches of the Yangtze River) or specific types of cities (e.g., resource cities, tourism cities, and coastal cities) [13,15,19–21]; however, few studies have investigated the resilience of border cities. At the same time, border cities, as an important urban type, have introduced the resilience theory to the border. This has important theoretical and practical significance for the problem of urban development.

However, due to the late start of research on border cities that involves the idea of resilience, the current research on border cities is still mainly focused on quantitative assessment and strategy selection, while articles that combine the two systems of border cities and urban resilience are still rare. Among them, as early as after the outbreak of the conflict in Afghanistan, some foreign scholars began to explore the war response capacity of border cities in the security sense [22], which is an early exploration of the relationship between security and resilience in border cities. Since then, scholars have targeted border cities in war-torn countries such as Afghanistan and Iraq, focusing on vulnerable human rights [23], ethnicity, and refugee flows in towns and cities [24,25]. DA Shirk focused on the vulnerability of countries in the Central American Caribbean, particularly in regard to Mexican border cities in which spillover crimes, such as those related to drugs and guns, threaten U.S. border states and counties [26]. With the tangible development of the cross-border cooperation of cities on both sides, studies have begun to focus on the relevance and coordination of border city cooperation with regard to ecological governance and technological advancement. F Yao et al. argue that the development of high-tech cooperation parks in border cities can help enhance economic relations between the two sides. Castanho et al. contribute to research on the European city of Elva-Bada by evaluating the impact of the 2013 Cross Border Cooperation (CBC) project that led to the successful creation of the European city of Elva-Badajoz, in which inter-city connectivity, mobility and political commitment guaranteed the sustainable development of the city [27]. On the domestic front, Chen Yewei and Ding Guanliang used an economic approach to evaluate the economic resilience scores of prefecture-level cities nationwide and developed a classification table with four levels of intensity [28]. By constructing an index system for evaluating the economic resilience of cities in the northeastern region, Mansan proposed corresponding suggestions for the further optimization of urban economic resilience based on both the openness characteristics of foreign trade and the openness characteristics of domestic trade in northeastern border cities in China [28]. Bai Limin and Xiu Chunliang et al. quantitatively assessed the resilience of cities above the prefecture level in China and

found that the overall resilience of cities along the border areas in China is low [29]. On the whole, due to the constraints of objective factors, such as data access and the sparseness of border cities, scholars at home and abroad have difficulties in obtaining the required data and combining them with field research when carrying out research. In addition, it is difficult to generate enthusiasm for research regions, such as core city clusters and coastal cities, and there is a lack of exploration of the spatial interactions and linkages between urban resilience systems and border systems in the academic community.

The external geopolitical environment of China's northeastern border areas is complex and changeable, and China has long faced a series of social and economic problems, such as serious population loss and declining urban vitality. Since China's State Council proposed the "14th Five-Year Plan", the northeastern border area has received widespread attention, and the state has issued a series of policies to support the development of the border area. In this context, this study considers Northeast China as the research area and covers the research period from 2010 to 2019. It constructs a border city resilience evaluation model using the basic resilience dimension and the exclusive resilience dimension of border cities in order to analyze the resilience state of the city, its evolution process in time and space, and its main obstacle factors. As the location at which all resources, such as population, economy and culture, in the border area are united, the development status of border cities can be regarded as a microcosm of the border region as a whole. The development of border cities is bound to be more challenged by the large number of border cities in northeast China, as well as the fragmented distribution and loose connection between large-medium cities and medium-small towns. Due to the connection of the border city with neighboring countries and the vast frontier, they are exposed to uncertain risks, such as security incidents and economic fluctuations, their vulnerability and sensitivity are more intense compared to those of inland hinterland cities or coastal cities, and their urban governance is more difficult. With the strong mobility, high sensitivity and economic externality of the border area, cities that gather regional resources inevitably face the pressure of natural disasters and human interference. While attracting population mobility and industrial agglomeration in border areas, ways in which to improve the ability of cities to cope with the disturbance of various factors and to adapt and recover after being affected is an urgent issue to be addressed in the development of border cities. The introduction of resilience perspectives and new methodology will provide a new way of thinking when studying the sustainable development of border cities. This study is beneficial in order to improve the theory of urban resilience, and is dedicated to exploring the urban resilience of the border areas of northeast China. While enriching the study of urban resilience, based on the border area of China, we expect to combine the theory of coordinating the human-land relationship in geography and contribute to the long-term sustainable and healthy development of Chinese border cities.

2. Conceptual Framework: Resilience Definition and Index System Construction of Border Cities

2.1. Definition and Characteristics of Border City Resilience

Urban resilience refers to the ability of an urban system to maintain or restore natural and social stability in the face of disturbances via the rational organization of resources [30]. This refers to the ability of a city to maintain basic social and economic construction. As a subsystem of the urban system, the resilience of border cities is universally relevant to the study of border cities. Second, as the main locations of material culture and security incidents in border areas, border cities have prominent border attributes compared to other types of cities. The free flow of goods and personnel drives urban development. However, this development may also be fragile, owing to the tension in the local relations between the two countries [4]. Therefore, based on the mechanisms of resilience, this study comprehensively considers the systematic characteristics of border cities and believes that the resilience of border cities refers to the regional resilience state that is formed by the interaction between the maintenance of the basic production and living conditions of cities,

and the conduct of a series of economic activities that are relayed to borders when they face various acute internal and external shocks and chronic pressures within the complex geographical environment at home and abroad (especially the influence of export-oriented economic fluctuations). At the same time, the administrative area of the Chinese border is large, and there are huge economic differences and discontinuities among cities. In addition to natural differences in geography and culture, the urban population and manufacturing activities (employment, foreign investment, and exports) brought about by local policy attraction explain most of the development gaps in border cities [31]. Considering that the efficiency of border resource flow and these cities' ability to cope with risks depend on the level of urban development, while urban operation also benefits from border location, the influencing factors and mechanism of the resilience of border cities are further explained on the basis of two dimensions, basic resilience and exclusive resilience; this is achieved through an in-depth exploration of the characteristics of the population and the economic activities of border cities that are different from the usual research areas (Figure 1).

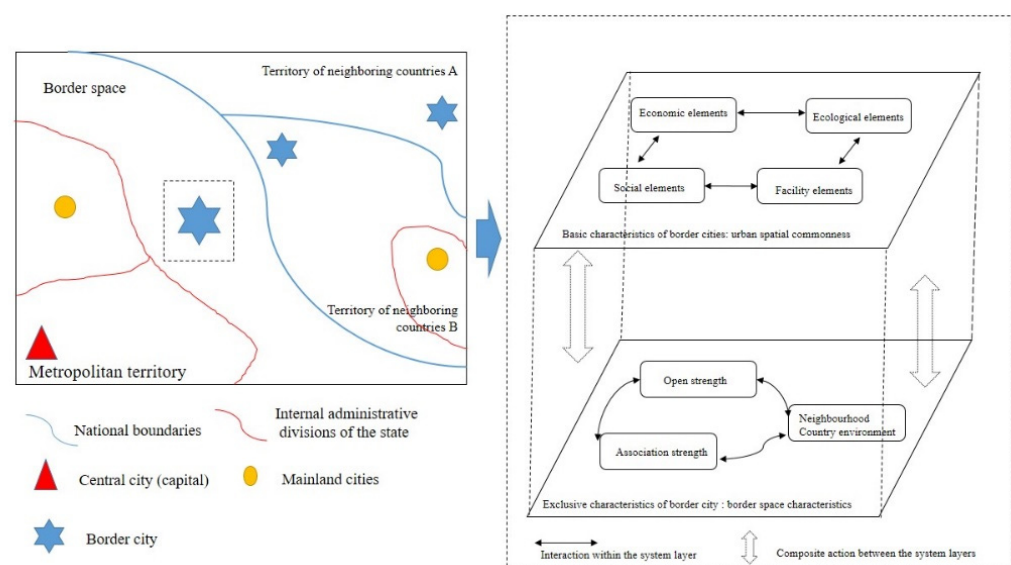


Figure 1. Schematic diagram and characteristic deconstruction of border cities.

The basic resilience of border cities refers to their stable states as city systems. This state means that in the face of a short- or long-term disturbance to the natural environment or to human activities, cities can improve their ability to cope with interference and resist risks in the current and future periods; this is through the close cooperation of cities in terms of economy, society, ecology, and facilities, in order to adapt to the impact, restore themselves to the original state and achieve the goal of sustainable development. The exclusive resilience of border cities refers to the development opportunities obtained through the complex interactions between “closed” and “open” cities, depending on national boundaries [32]. Border cities generally start life as a place in which to gather resources in the border areas, which gradually develops into a large city. Since their formation, internal and external environments have affected the development of border cities. Whether the environment of the neighboring countries is stable, border cities' strength of contact with internal and external cities, and their degree of opening to the outside world, determine their exclusive resilience. The urban resilience of border cities is measured through these two dimensions. Based on basic urban and exclusive border resilience, an interactive system of basic resilience (urban system) and exclusive resilience (border system) is formed.

Overall, the research on the resilience of border cities has the following characteristics:

- a. Complexity and diversity: The resilience of border cities involves comprehensive and diverse elements, which form a whole via the coupling of the urban system in

order to deal with interference and sustainable development, the urban interior and surrounding cities, production, life, and the ecosystem. At the same time, the regional differences, the city's development conditions, and different practical problems cause diversity in the resilience implementation process of border cities.

- b. Uniqueness: The resilience research of border cities has something in common with previous research on urban resilience. It also has a particularity owing to the shielding and intermediary role of border locations in terms of nature, society, economy and trade, and geography.
- c. Dynamics: Changes in the environment and the disturbance of various uncertain factors cause the resilience levels of border cities to fluctuate over time.

2.2. Construction of Evaluation Index System for Border Cities Resilience

This study begins with a definition of border city resilience and refers to existing measurements and evaluations of urban resilience at home and abroad [11,16,33]. Based on the principle of scientific systems and operability, the evaluation index system of the resilience level of border cities is constructed using the basic and exclusive resilience dimensions. Specifically, 22 secondary indicators are included, in which the positive or negative nature of the indicator indicates its enhanced or weakened impact on the resilience of border cities (Table 1). Considering that the selected index data are significantly different in terms of units and orders of magnitude, and that the positive and negative directions are distinguished, a standardized method is used for the dimensionless processing of data.

Table 1. Evaluation Index System of Border Cities' Resilience.

Resilience Dimension	First Level Indicator	Second Index	Indicator Meaning	The Nature of Indicators
Basic resilience	Economy	Per capita GDP/(yuan/person)	Economic base	+
		Urban and rural residents' savings/billion CNY at the end of the year	Economic potential	+
		Proportion of tertiary industry to GDP/%	Economic structure	+
	Society	Total urban resident population/person	City size	+
		The proportion of education expenditure in fiscal expenditure/%	Educational input	+
		Natural population growth rate/%	Development potential	+
		Unemployment rate/%	Social pressure	−
	Ecology	Social insurance index ¹	Residents' living security	+
		Sulfur dioxide emissions per square kilometer/(ton/km ²)	Environmental pollution pressure	−
		Greening coverage rate/% in built-up areas%	Urban greening level	+
		Domestic waste harmless treatment rate/%	Ability of environmental management	+
	Facility	Drainage pipe density/(km/km ²)	Municipal engineering construction	+
		Number of beds in medical institutions per ten thousand people	Expenditure for public health	+
		The proportion of broadband Internet access/%	Information technology popularization	+
Exclusive resilience	Open strength	Total imports and exports/billions of dollars	Opening degree	+
		Actual utilization of foreign capital/ten thousand dollars	Attractive to foreign investors	+
		Total import and export/GDP (%)	Ratio of dependence of foreign trade	+

Table 1. Cont.

Resilience Dimension	First Level Indicator	Second Index	Indicator Meaning	The Nature of Indicators
		Border cities supported by national policies ²		
		(1) State Council Approved a Class of Opening Ports		
		(2) Key development and opening up pilot area	Policy support	+
		(3) Frontier national ports		
		(4) Border economic cooperation zone		
		(5) Cross-border economic cooperation zone		
	Neighboring environment	Index of vulnerable neighboring countries	Vulnerability of neighboring countries	–
		UN Human Development Index of Neighboring Countries	Development level of neighboring countries	+
	Association strength	Distance from border cities to central cities in administrative districts/km	Internal contacts	–
		Distance between border cities and neighboring border port cities/km ³	Contacts with overseas parties	–

Note: ¹ Social insurance index indicates the proportion of urban residents with various types of insurance in the total urban population, and ² measures the strength of the city supported by national policies (1–5 assignments according to the above five policy conditions, each corresponding to 1 point). ³ According to the foreign economic and trade information in the United Nations database, the General Administration of Customs, and the statistical yearbooks of various provinces and regions, the important border port cities of neighboring countries selected are Choybalsan of Mongolia; Vladivostok, Ussulisk, Khabarovsk, and Bragovitchshensk of Russia; and Xinyi Prefecture, Huishan, and Manpu of the DPRK.

a. The basic resilience dimension: Border cities are common indicators of urban systems, and the priority areas of the economy, society, ecology, and facilities are considered according to the theme of urban resilience research [34]. Among them, the economy is the foundation of urban resilience and the fundamental driving force for improving environmental quality and social progress, mainly including economic foundation, economic potential, and economic structure. As the institutional guarantee of urban resilience, social factors provide grassroots support for material development, including urban scale, education investment, development potential, social pressure, and residents' living security. The ecological construction of the city's green barrier in order to create a livable ecological city that is able to prevent floods and mitigate pollution is of great significance; this is achieved via the characterization of environmental pollution, a good level of urban greening, and the determination of the environmental governance capacity index measure. Facilities are key material elements and direct realistic factors that ensure the quality of life of residents; they are mainly reflected in municipal engineering infrastructure, medical and health investment, and information technology popularization. Secondary indicators that represent these four areas are selected to measure the basic resilience of border cities.

b. The exclusive resilience dimension: The border city is the characteristic index of the urban system, and the three indexes of open strength, neighboring environment, and association strength are selected. Since border trade has a significant effect on the development of border cities, foreign trade in border cities plays an important role in opening up these factors [35]. Additionally, national policy support plays a role in promoting the resilience of border cities. By considering the National Border Economic Cooperation Zone approved by China's Ministry of Commerce in 1992, the first class of ports approved by the General Administration of Customs, and the list of key border areas published by the State Council in 2016, the national policy support for border cities was judged in order to assign indicators. The environmental factors of neighboring countries are external and uncontrollable factors that are faced by border cities at all times. Referring to existing research, the Fragile State Index and United Nations Human Development Index are used

to characterize the influence of the geographical environment of neighboring countries on China's border cities [36,37]. A reduction in the fragile state index of the neighboring target countries and an improvement in their human development index can create a good external environment and ensure the resilience of domestic border cities to a certain extent. Considering the geographical location of the border cities inside and outside the country, the distance from the central city within the same administrative area affects the flow of resources to the border cities in the region and the support response after the crisis. The geographical distance between the border port cities of different countries determines the convenience of cross-border trade interaction [4]. The closer the distance, the easier the connection, and the better the development opportunities for the target cities.

3. Overview and Research Methods of Study Area

3.1. Overview of Study Area

The northeastern border cities in this study included 14 municipal (state and alliance) administrative regions along the eastern border of Liaoning Province, Jilin Province, Heilongjiang Province, and the Inner Mongolia Autonomous Region, which border the DPRK, Mongolia, and Russia, respectively (Figures 2 and 3). The region covers 14 prefecture-level cities, 38 cities, and several counties, with a total area of 6033.98 million square kilometers; this is 52% of the total land area in Northeast China, and its population accounts for 18.97%. This study considered 14 prefecture-level cities as basic research units. Cities in the northeastern border region have long faced a series of problems, such as the loss of population to varying degrees, idle land and housing, stagnant economic development, the declining vitality of urban development, and a realistic environment, such as the low level of opening up of external neighboring countries and the remoteness of border areas far from their economic centers.

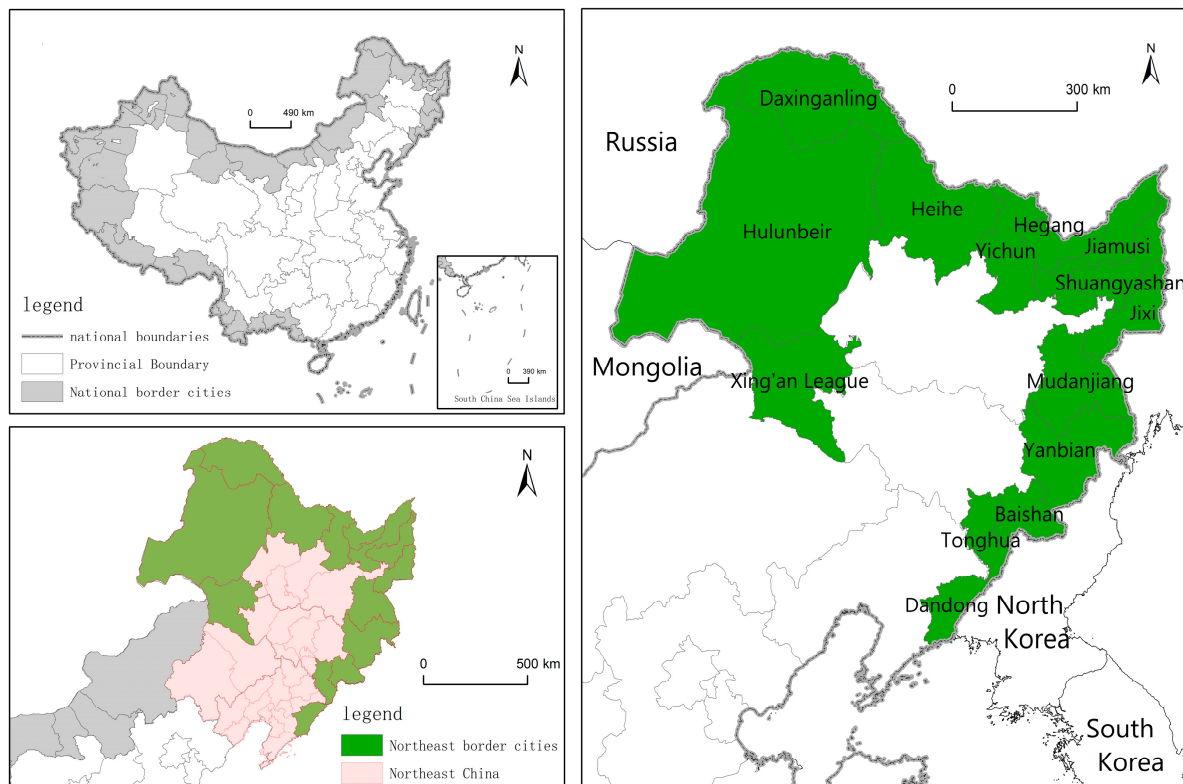


Figure 2. Location of the study area.

Study Area		Border with DPRK	Border with Russia	Border with Mongolia
Liaoning Province	Dandong			
Jilin Province	Tonghua			
	Baishan			
	Yanbian			
Heilongjiang Province	Mudanjiang			
	Jixi			
	Shuangyashan			
	Jiamusi			
	Hegang			
	Yichun			
	Heihe			
	Daxing'anling			
Inner Mongolia Autonomous Region	Hulunbeier			
	Xing'an League			

Figure 3. The provinces to which the study area belongs and the bordering countries.

3.2. Data Source

This study selected 13 prefecture-level cities in the northeast border area (including the Xing'an League and Yanbian Korean Autonomous Prefecture, in which the Greater Hinggan Mountains area was not studied due to difficulties in obtaining data) as the research area at the spatial level. Regarding the study period, three time nodes were selected: 2010, at the early stage of China's twelfth five-year plan; 2015, at the end of China's twelfth five-year plan; and 2019, at the end of China's thirteenth five-year plan. The research panel data mainly came from the China City Statistical Yearbook; the Statistical Yearbook of Heilongjiang, Jilin, Liaoning, and Inner Mongolia from 2010 to 2019; and the Statistical Yearbook of Urban Construction of the Ministry of Housing and Urban Development, supplemented by the statistical bulletin of each city. The policy data were derived from the list of key border areas issued by the Ministry of Commerce of the People's Republic of China, the Port Administration Office of the General Administration of Customs, and the State Council's Views on Several Policy Measures to Support the Development and Opening up of Key Border Areas. The national vulnerability index was from The Fund For Peace website; the United Nations Human Development Index (HDI) came from the United Nations Development Programme (UNDP); and geographic distance was calculated using the Baidu map-picking coordinate system and ArcGIS software. The missing data were supplemented by interpolation.

3.3. Research Methods

3.3.1. Entropy Weight–TOPSIS Evaluation Model

In this study, a TOPSIS evaluation model based on entropy weights was used to measure the urban resilience of the northeast border areas. The advantages of the entropy-weight TOPSIS model include its operability and reasonable results. Therefore, this study selected the entropy weight–TOPSIS model according to the methods used in existing research in order to quantitatively and objectively evaluate the resilience levels of northeastern border cities [38]. The specific steps were as follows:

- a. Data after normalization were normalized and the weights of each indicator were determined using the entropy weighting method.

- b. The weight vector u_j that was obtained using the entropy weighting method was considered in the decision matrix, and the weighted normalized decision matrix was obtained by multiplying each row of the matrix R with its weight u_j as $V = (v_{ij}) m \times n$

$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mn} \end{bmatrix} = \begin{bmatrix} r_{11} \cdot u_1 & r_{12} \cdot u_1 & \cdots & r_{1n} \cdot u_1 \\ r_{21} \cdot u_2 & r_{22} \cdot u_2 & \cdots & r_{2n} \cdot u_2 \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} \cdot u_m & r_{m2} \cdot u_m & \cdots & r_{mn} \cdot u_m \end{bmatrix} \quad (1)$$

- c. Positive and negative ideal solutions were sought, where Z^+ denotes the optimal solution and Z^- denotes the inferior solution.

$$Z^+ = \{ \max Z_{ij} | i = 1, 2, \dots, m \} = \{ Z_1^+, Z_2^+, \dots, Z_n^+ \} \quad (2)$$

$$Z^- = \{ \min Z_{ij} | i = 1, 2, \dots, m \} = \{ Z_1^-, Z_2^-, \dots, Z_n^- \} \quad (3)$$

- d. The distances D^+ and D^- of the evaluation vectors were calculated to Z^+ in different zones, separately.

$$D_j^+ = \sqrt{\sum_{i=1}^m (Z_{ij} - Z_i^+)^2} \quad (i = 1, 2, \dots, m) \quad (4)$$

$$D_j^- = \sqrt{\sum_{i=1}^m (Z_{ij} - Z_i^-)^2} \quad (i = 1, 2, \dots, m) \quad (5)$$

- e. The closeness of the target to the ideal value was calculated and ranked.

$$C_j = \frac{D_i^-}{D^+ + D^-} \quad (1 \leq j \leq n) \quad (6)$$

At the same time, we calculated the evaluation value of the resilience of the northeastern border cities.

3.3.2. Obstacle Model

To clarify the shortcomings that restrict improvements in the resilience of border cities, the obstacle degree model was used to analyze the obstacle factors of the resilience of northeast border cities. The obstacle degree model uses the index deviation degree, factor contribution degree, and obstacle degree for analysis and evaluation [39]. The index deviation degree is the gap between each index and the evaluation goal of urban resilience, the factor contribution degree reflects the influence of a single index on urban resilience, and the obstacle degree is the negative impact value of a single index on urban resilience. As the selected indicators are deterministic in various statistical yearbooks, the contribution and deviation of the factors were not analyzed; however, the obstacle factors were analyzed in depth according to the degree of obstacles. The formula used was as follows:

$$M_j = O_{ij} \times F_j \times 100\% / \sum_{i=1}^n F_j \times O_{ij} \quad (7)$$

In the formula, O_{ij} represents the deviation of the j th index of city i , and represents the standardized value of a single index. F_j is the factor contribution of the j th index, and M_j is the obstacle degree of the j th index of city i .

4. Spatial–Temporal Differentiation of Resilience of Northeastern Border Cities

The entropy weight–TOPSIS method was used to calculate the basic, exclusive, and comprehensive resilience of 13 cities along the border of Northeast China in 2010, 2015, and 2019, respectively. The Jenks natural breakpoint method was used to divide the resilience evaluation value into five grades, and the grading criteria for the resilience of the border cities under each dimension were obtained (Table 2). ArcMap software was used to link the measured resilience values with the data in the vector format of the study area, and a spatial distribution map of the resilience of the northeastern border cities in 2010, 2015, and 2019 was created (Figures 4–6).

Table 2. Criteria for resilience grade of northeast border cities.

Urban Resilience Grade	Basic Resilience of Border Cities	Exclusive Resilience of Border Cities	Comprehensive Resilience of Border Cities
Low resilience	$R \leq 0.2094$	$R \leq 0.3684$	$R \leq 0.3598$
A lower resilience	$0.2094 < R \leq 0.4736$	$0.3684 < R \leq 0.5030$	$0.3598 < R \leq 0.5334$
Moderate resilience	$0.4736 < R \leq 0.5709$	$0.5030 < R \leq 0.5557$	$0.5334 < R \leq 0.6001$
Higher resilience	$0.5709 < R \leq 0.6982$	$0.5557 < R \leq 0.7112$	$0.6001 < R \leq 0.7124$
High resilience	$0.6982 < R \leq 0.9108$	$0.7112 < R \leq 0.8485$	$0.7124 < R \leq 0.8474$

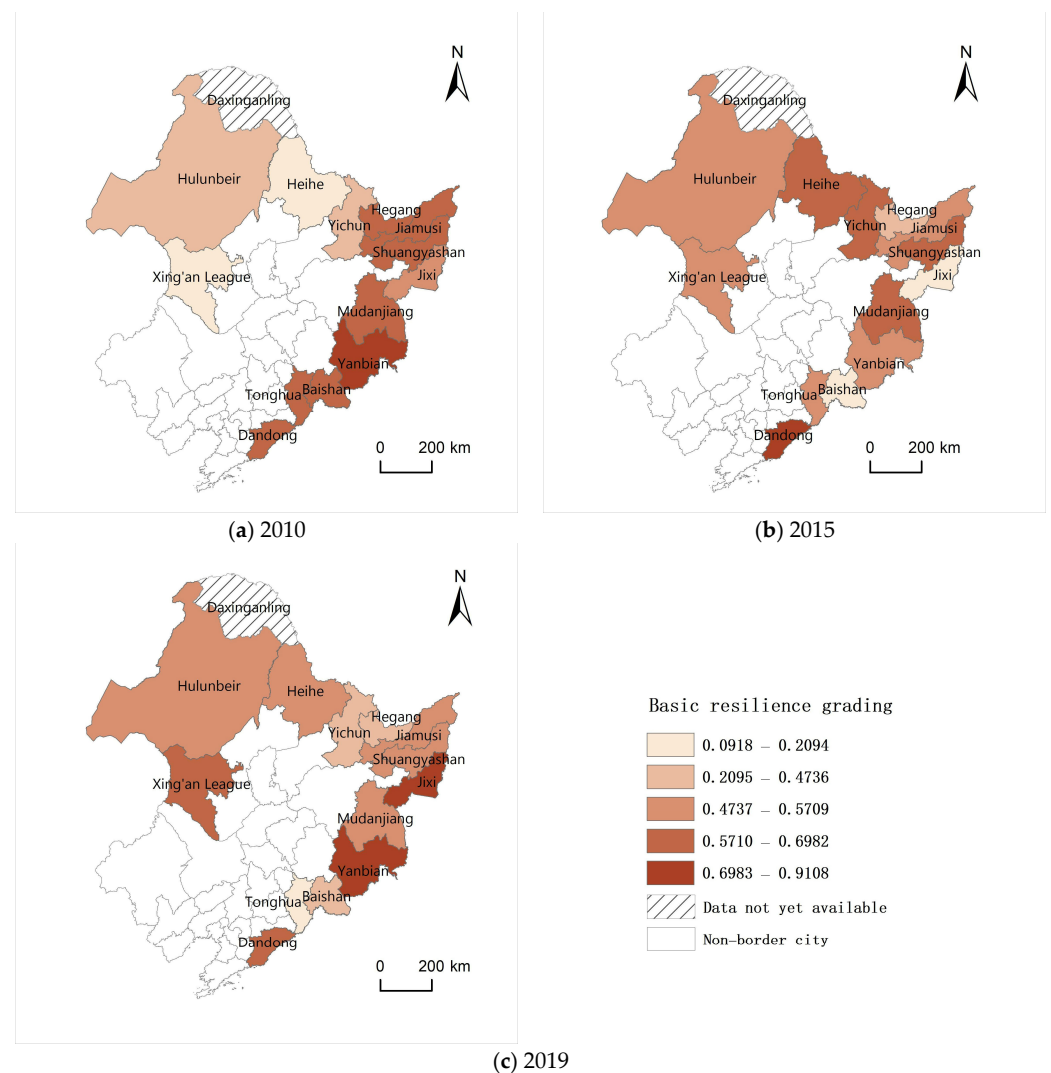


Figure 4. Spatial distribution of basic resilience of northeast border cities in 2010, 2015, and 2019.

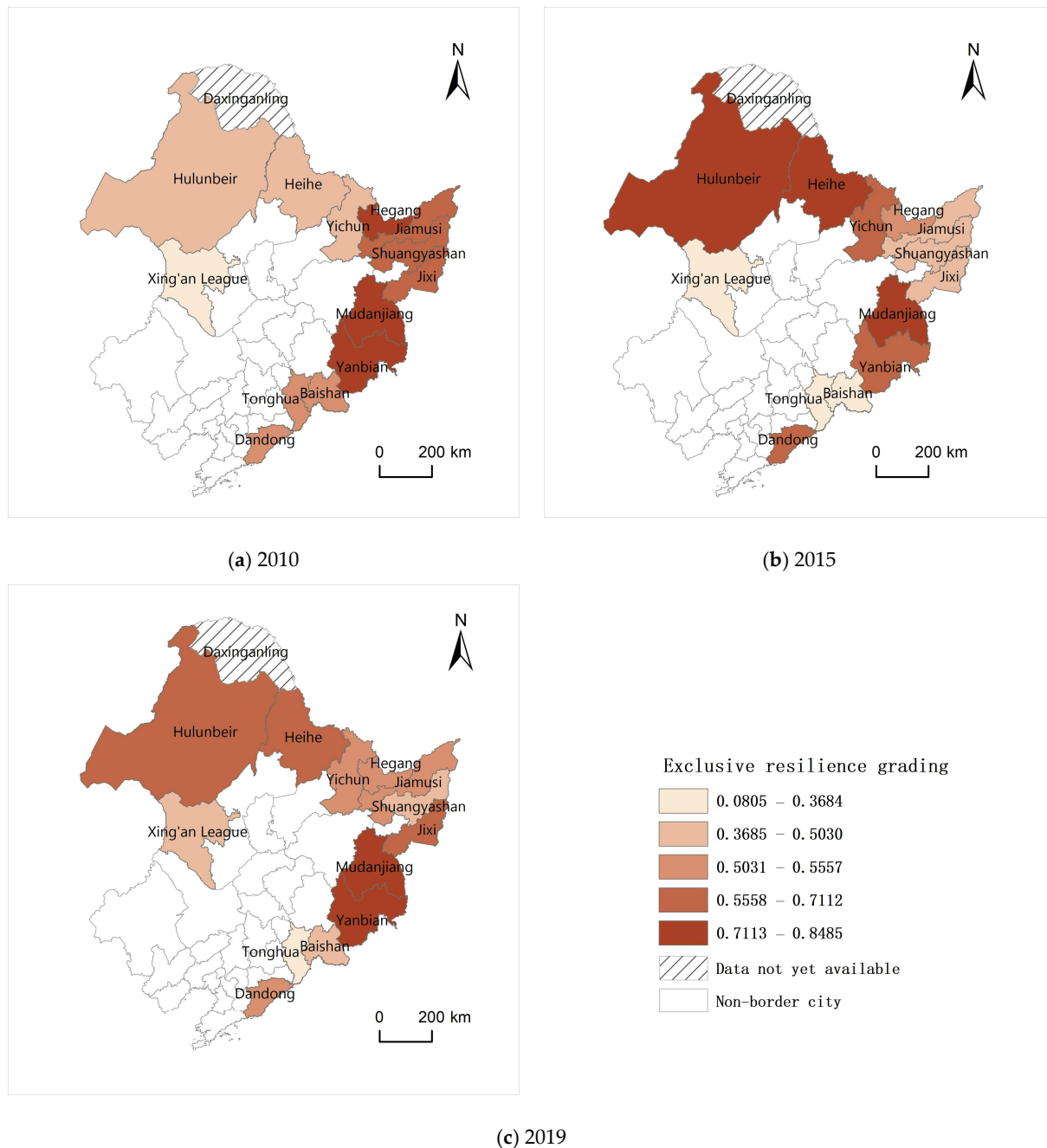


Figure 5. Spatial distribution of exclusive resilience of northeast border cities in 2010, 2015, and 2019.

4.1. Basic Resilience of Northeast Border Cities

From a spatial point of view, the basic resilience level of the northeastern border cities generally presents a trend of “high in the east and low in the west”. The low-resilience area is mainly concentrated in the northwest of Heilongjiang and in small cities with sparse populations and weak economic foundations in the eastern part of Mongolia. The high-resilience area is mainly concentrated in large and medium-sized cities with a high degree of urbanization and a good economic foundation in the eastern part. Combined with practical factors, it is found that Xing’an League, Hulunbuir, Heihe, and Yichun in the western region have been in the weak areas of economic development and infrastructure construction for a long time. Except for Hulunbuir, the per capita GDP of the other cities is lower than the overall level of the region. At the same time, they are faced with various social problems, such as a small urban population base, a high unemployment

rate, and insufficient investment in education. Cities located in the east generally have the advantage of good industrial and urban infrastructures. Among them, Dandong City in Liaoning Province, Yanbian Korean Autonomous Prefecture in Jilin Province (hereinafter referred to as Yanbian Prefecture), Mudanjiang City in Heilongjiang Province, and Jixi City in Heilongjiang Province have the best development conditions. However, insufficient living security, low government efficiency, and insufficient vitality caused by long-term population loss are common factors that restrict the generation of improvements in the resilience of these cities (Figure 4).

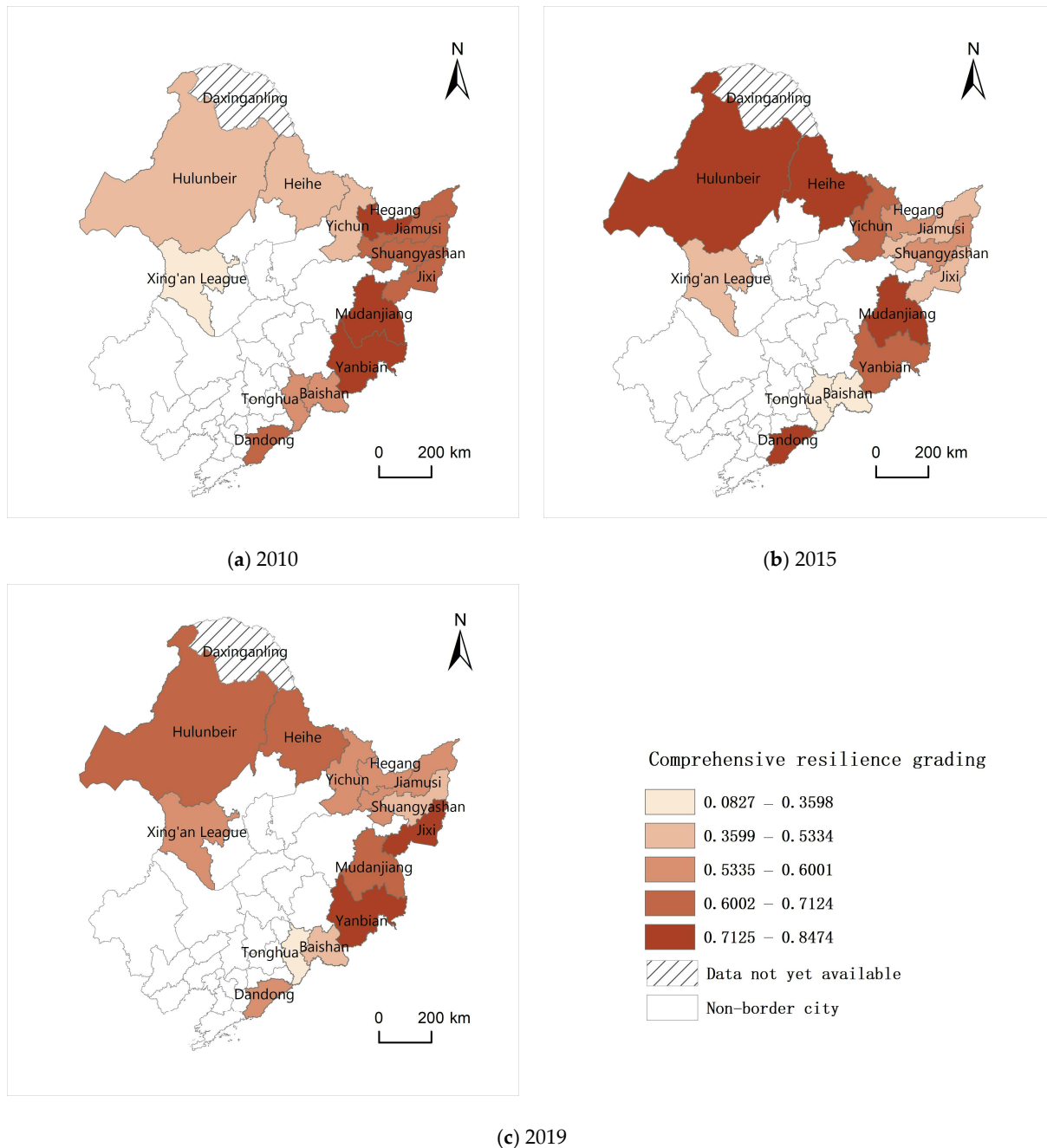


Figure 6. Spatial distribution of comprehensive resilience of northeast border cities in 2010, 2015, and 2019.

Regarding time, there is a process of “first west and then east” resilience improvement. In the past 10 years, from 2010 to 2019, the basic resilience level of the northeastern border cities has generally shown an upward trend. Among them, the low-level resilience cities

in the west, represented by the Xing'an League, Hulunbeir, and Heihe, showed the most obvious improvement in the first five years. With the Western development strategy in 2010 entering the stage of accelerated development, eastern Mongolia benefited from the support of the state and the Inner Mongolia Autonomous Region to achieve rapid economic and social development. Second, the western region, including Heihe and Yichun, is located in the Hulunbeier grassland and foothills of the Greater Hinggan Mountains and lacks a heavy industry layout. Owing to their excellent long-term urban ecological environment, the basic resilience of these cities has improved significantly. During the five years from 2015 to 2019, although the overall basic urban resilience continued to improve, the growth rate slowed. In addition, mainly in eastern Yanbian, Jixi and Jiamusi, as well as Dandong and Tonghua, basic city resilience decreased significantly; this shows that border city development vitality is limited, and that it is difficult to attract talent and industry.

4.2. Exclusive Resilience of Northeast Border Cities

From a spatial perspective, the exclusive resilience dimension of the northeastern border cities generally presents a “high–middle–low” distribution trend in the region. High-resilience cities are concentrated in the northwest and eastern regions, including Hulunbeier in Inner Mongolia, Heihe in Heilongjiang, Mudanjiang, and Yanbian Prefecture in Jilin Province. There is a high-resilience city at the exclusive dimension level at the boundary of the administrative area, which reflects the historical basis and realistic environment of the development of border cities with a geographical advantage in terms of location. For example, as the window of trade between China and the DPRK, the Chinese Koreans in Yanbian Prefecture have played a positive and important role in transforming Yanbian into the center of China–DPRK border trade; Heihe is one of the cities that first opened in the country, owing to its excellent location in the Russian Far East; Manzhouli, which has recently become a “holiday paradise for Russian tourists”, offers Hulunbuir a new point of growth (Figure 5).

Regarding time, from 2010 to 2015, northeast China as a whole showed the trend of “fast west to slow east”, and the exclusive resilience level of border cities in western China increased significantly. During this period, the western region, represented by Hulunbeier and Heihe, benefited from the support and guidance of the Ministry of Finance for the establishment of national border economic cooperation zones in 2012 and made great progress in attracting foreign investment and opening up. From 2015 to 2019, it showed a trend of “fast in the east and slow in the west”. The level of exclusive resilience in the eastern region rapidly increased, with Jixi, Mudanjiang, and Yanbian at the core. During this period, in addition to the active participation of cities in cross-border trade, a stable and good external environment provided important opportunities for the development of border cities. As the eastern part of Northeast China has a long border with the DPRK, the DPRK's long-term performance of nuclear tests and subjection to repeated international sanctions have limited its domestic development and threatened the security of China's border cities. Since 2013, the DPRK has released a signal to strengthen international exchanges through the “Economic Development Zone Act” and has actively promoted border trade cooperation with China in Manpu and Huishan, improving the exclusive resilience of cities in the eastern region adjacent to the DPRK.

4.3. Comprehensive Resilience of Northeast Border Cities

From the overall calculation, the comprehensive border city basic resilience and exclusive resilience of the two dimensions, as captured in Figure 6 within the first period (2010–2015), is the northeast border city resilience level of the “enhance the transition period”. Generally, showing a comprehensive and rapid improvement trend, this period in the western cities discards the low-resilience development state. The second period (2015–2019) is the “inefficient development period” of the resilience level in the northeast border cities, which generally slows down and fluctuates locally. According to the specific time node interpretation, (1) Hegang, Jiamusi, Mudanjiang, and Yanbian were moderately

resilient cities in 2010, and are now low-resilience cities; (2) In 2015, the comprehensive resilience level of border cities improved significantly. In addition to Jiamusi's resilience level decreasing to a low level, the resilience levels of Hegang, Jixi, Baishan, and Tonghua showed an upward trend. (3) In 2019, the comprehensive resilience level of Jixi rose to high resilience, and the resilience of Xing'an League and Jiamusi increased from low resilience to moderate and medium-high resilience. The original high resilience levels of Yichun and Dandong decreased to moderate resilience, and their cities maintained their original resilience state or decreased from the medium-high level to the medium-low level (Figure 6).

In general, the resilience of the northeastern border cities has changed significantly over the past 10 years. The entire study area shows significant upward development in the early stages of urban resilience and tends to stagnate in the later stages. Some cities tended to experience a decline. The resilience of each city increased rapidly between 2010 and 2015. By 2019, the effect of urban resilience improvement was not evident, and the three cities had low, medium, and low resilience levels. Jixi showed the most obvious improvement and became one of the five cities with high resilience. From the perspective of urban development trajectory, Hulunbeier in eastern Inner Mongolia, Heihe in Heilongjiang Province, Mudanjiang, Yanbian Prefecture in Jilin Province, and Dandong in Liaoning Province maintained a high level of resilience for a long time. It is difficult for the northern cities of Heilongjiang Province to achieve a high level of breakthrough when they face a lack of stamina in terms of improving resilience. The resilience levels of border cities in Jilin Province are declining and are difficult to improve.

5. Analysis of Obstacle Factors for Improving Resilience of Northeast Border Cities

To determine the main factors that hinder improvements in resilience in the northeastern border cities, the obstacle degrees of each index in each year of each city are calculated using Formula (1), and the annual obstacle factors of the largest individual cities M_j are marked. The obstacle factors and obstacle degrees of basic and exclusive resilience for each city in 2010, 2015, and 2019 are presented in Table 3.

Table 3. Obstacles to Resilience in Northeast Border Cities in 2010–2019.

	2010				2015				2019			
	Basic Resilience		Exclusive Resilience		Basic Resilience		Exclusive Resilience		Basic Resilience		Exclusive Resilience	
	OF	OD	OF	OD	OF	OD	OF	OD	OF	OD	OF	OD
Xing'an League	X4	8.34	X19	10.06	X4	7.45	X19	10.38	X3	7.18	X20	9.81
Hulunbuir	X4	9.05	X19	7.75	X4	7.92	X19	8.71	X8	8.33	X19	8.19
Heihe	X4	9.84	X21	6.93	X4	9.05	X21	7.05	X4	10.36	X21	7.89
Yichun	X6	10.65	X21	5.02	X6	7.57	X16	5.27	X6	8.65	X18	7.59
Hegang	X3	5.96	X16	5.6	X1	6.73	X18	5.73	X11	8.35	X18	7.22
Kiamusu	X12	6.08	X19	6.03	X8	7.63	X18	6.7	X8	6.5	X18	6.43
Shuangyashan	X3	6.14	X16	5.55	X4	10.32	X16	6.26	X3	9.79	X18	7.66
Jixi	X11	6.03	X22	6.11	X6	9.92	X22	5.6	X3	7.76	X22	6.31
Mudanjiang	X5	6.26	X21	6.09	X10	14.18	X21	6.16	X10	14.1	X21	7.84
Yanbian	X4	6.84	X22	7.04	X7	6.1	X22	6.46	X8	7.71	X20	6.8
Baishan	X11	7.94	X20	6.89	X11	24.2	X20	6.8	X11	15	X20	8.9
Tonghua	X4	6.22	X20	7.07	X3	8.29	X20	10	X11	19.23	X20	9.2
Dandong	X11	10.74	X20	7.99	X1	6.64	X20	11.9	X6	7.04	X20	14.9

Note: OF—obstacle factors. OD—obstacle degree.

According to the results of the analysis, from 2010 to 2019, regarding basic city resilience, Xing'an League, Hulunbuir, Heihe, Shuangyashan, Yanbian Prefecture, and Tonghua were all restricted by the scale of the cities' social factors, among which Heihe had the longest duration and the greatest obstacles. Specifically, Xing'an League, Hulunbeir, Heihe, Yanbian, and Tonghua, five cities located in grassland and forest areas, experienced difficulty forming large- and medium-sized cities owing to the sparse population in the

region and the complex geographical environment. For such cities, it is recommended that the agglomeration of surrounding populations is promoted in order to improve the level of urbanization. In 2015, Shuangyashan's city-scale obstacle level reached 10.32, and long-term population loss, when exposed to its representative of the northeast resource-based cities, faces contradiction. In addition, the obstacle factors of Shuangyashan in 2010 and 2019, and the first two stages of Hegang, are prominently manifested in the economy, and are especially restricted by the economic structure. In the past, a single dependence on coal mining and difficulties regarding industrial transformation have hindered improvements in the economic resilience of resource-based cities. The optimization of the urban economic structure requires the long-term efforts of local and national governments. Relying on border locations to develop port trade and optimize the layout of import and export enterprises may become an opportunity for such urban transformation. The cities that are more restricted by urban ecological factors are Jixi, Mudanjiang, Tonghua, Baishan, and Dandong. The urban ecological environment of Jixi and Dandong was found to no longer be the main obstacle factor after 2010, but a rise in the number of economic and social indicators has become the main contradiction. The ecological factors of Mudanjiang are related to a lack of urban greening, whereas Tonghua and Baishan exhibit poor environmental governance. For such regional cities, Mudanjiang should appropriately increase the area of urban public green space and the number of parks and squares in order to improve the happiness of residents. Tonghua and Baishan need to increase investment in environmental protection, strengthen environmental governance, and improve the quality of border tourism by relying on the natural landscape of the Changbai Mountains.

Among the exclusive resilience barriers of border cities, the main constraints of Hegang and Shuangyashan in 2010 were found to be the lack of foreign investment attraction regarding the opening-up factor; Xing'an League, Hulunbeir, and Jiamusi are all vulnerable to their neighboring countries in terms of their environmental factors; Baishan, Tonghua, and Dandong are restricted by the development level of neighboring countries; Yichun and Mudanjiang are mainly restricted by the distance between them and the provincial capital cities in terms of contact intensity factors; Jixi and Yanbian are subject to geographical location factors and are far away from the important port cities of neighboring countries. In 2015, except for Yichun, Hegang, Jiamusi, and in relation to other obstacles, the cities did not change. In 2019, the obstacle factors for the four cities mainly involved policy support under the degree of opening up, which was still restricted by the environment of neighboring countries and the intensity of ties. On the one hand, improvements in the exclusive resilience dimension of the northeastern border cities are based on improvements in the basic resilience of the city and rely on the development of the domestic market in order to improve the benefits of opening up. On the other hand, relying on the high urbanization level and excellent industrial foundation of the northeast border cities actively promotes the coordination and adaptation of related industries and infrastructure construction in the border areas, and then affects the overall resilience of the border cities. Given the objective laws of Jixi and Mudanjiang, which are subject to geographical distance factors regarding the attenuation of intercity connections, the adverse effects can be alleviated by building high-speed rail, connecting the road network with neighboring countries, and developing air transportation. In terms of national policies, based on the existing first and second types of opening-up ports in each city, the state's investment in pilot areas in Hulunbeir, Mudanjiang, Yanbian, and other places has achieved fruitful results in the past 10 years. In contrast, the development of border cities with poor original foundations and prominent geographical disadvantages will face greater challenges, particularly as it is difficult to obtain national policy support. To cope with the geo-environmental pressure of neighboring countries, China should take advantage of being based in Northeast Asia, and adhere to the attitude of cooperation and tolerance. In addition its "Belt and Road" initiative should be connected with Mongolia's "Grassland Road" and Russia's "Eurasian Economic Union" plan through land ports such as Manzhouli and Suifenhe, in order to further develop friendly cooperation with neighboring countries.

Overall, we should strengthen the relationship between the basic and exclusive dimensions of the resilience of border cities, consolidate and improve the basic resilience of cities, highlight the advantages of urban exclusive resilience, overcome the main obstacles, consider the northeast border cities to be the opening door of the northeast region, rely on China's technology, capital, and market, make use of the existing railway and highway transportation infrastructure that connects the country with Russia, Mongolia, and Korea, and use this as a passage through which to carry out land–sea intermodal transport, develop the northeast border cities into the primary growth zone of the border areas, promote the development of the northeast hinterland, and strengthen national exchanges using economic cooperation in order to form a safe and effective border-opening platform.

6. Discussion

As a place for economic and cultural exchange between countries in border areas, the development of border areas has an equally important role in security. As a spatial carrier for gathering various resources in this area, the study of resilience provides new ideas for exploring the spatial governance and sustainable development paths of border areas, which differ from inland and coastal areas. This is conducive to compensating for the shortcomings of urban development, giving full play to the geopolitical and economic advantages of border areas, and has far-reaching strategic significance for maintaining national and regional security. This paper is different from the existing research on border cities in the development of northeast China; its innovative aspect is that it proposes the construction of an “urban basic space–border exclusive space” measure of resilience model. Based on the overall area view, it is difficult to emphasize the special part of China's border city system, so it is difficult to examine the objective reality of the development of border cities. After the “border area” was artificially designated as a “frontier” with certain administrative boundaries, the established cities rely on the resources in the border area for development, and the development level of the border cities feeds back to the border. Therefore, this study suggests that the elements of border areas and border cities are closely linked, that the relationship is complex, and it thus considers the key factors for improving the resilience of both cities. Considering the border cities of Northeast China as the study objects, we measured the differences in the duration of resilience and spatial levels in the basic and exclusive layers, respectively. We then analyzed the obstacles to the resilience level and linked them with the actual development situation in order to provide countermeasures and suggestions for high-level resilience development in China's northeast border cities [40].

Among the basic resilience obstacle factors of border cities, the main focus is on the constraints of economic, social and ecological aspects.

(1) For cities mainly constrained by economic factors, such as Shuangyashan and Jixi, their economic resilience has been hindered by their single reliance on coal mining and difficulties in relation to industrial transformation in the past. These cities should focus on cultivating new industries and high-tech industries so that they gradually replace resource-based industries as those leading the city's economic development. At the same time, fully relying on national policies, they should take the revitalization of old industrial bases as an opportunity to adjust industrial structure, strengthen institutional innovation and the drive for scientific and technological innovation, make their industrial types gradually transform into diversified structures, stimulate market vitality and take the path of sustainable development.

(2) Some cities have been mainly constrained by social factors, such as Heihe and Yanbian. Taking Heihe as an example, it has long been constrained by social factors in terms of city size, which has a long duration and is related to a high number of obstacles. While promoting the development of new urbanization, Heihe should fully utilize its position as an important window for opening up to the north along the “Belt and Road” in order to promote flexible industrial development and achieve sustainable development through the integration of production, life and ecology.

(3) Some cities are mainly constrained by ecological factors, such as Mudanjiang, Tonghua and Baishan. The ecological constraints of Mudanjiang are mainly its insufficient level of urban greening, while Tonghua and Baishan have poor environmental management capacities. These cities should improve their productivity and production efficiency, expand the scale of production, create a livable and moderate life, improve the ecological environment, establish greening space, appropriately increase the area of public green space and the number of parks and squares in urban areas, and enhance the happiness of residents. At the same time, they should increase investment in environmental protection, strengthen environmental governance, take practical measures to strengthen the environmental protection governance system, and improve the quality of border tourism by relying on the humanities and the natural landscapes characteristic of the northeast.

Among the barriers to the exclusive resilience of border cities, the constraints are mainly concentrated in three aspects: opening up to the outside world, territorial environment and linkage strength.

(1) For cities that are mainly constrained by external opening factors, such as Yichun and Hegang, the scale of production should be expanded by introducing large-scale foreign direct investment, which can effectively solve the problem of insufficient capital in regional economic construction; in addition, capital formation should be promoted, thus promoting sustainable economic development. Regions with mainly agriculture should develop agricultural products with special characteristics for export at home and abroad. Regions that mainly develop mineral resources should try to find a replacement industry in order to stop relying on resource benefits and seek multi-faceted development.

(2) Cities that are mainly constrained by environmental factors in the territory, such as Dandong, Xing'an Meng, Baishan, and Hulunbuir, should continue to base their development on Northeast Asia, uphold a cooperative and inclusive attitude, and combine China's "Belt and Road" initiative with Mongolia's "Steppe Road" and Russia's "Eurasian Economic Road" through land ports such as Manzhouli and Suifenhe. The "One Belt and One Road" initiative of China, the "Steppe Road" of Mongolia and the "Eurasian Economic Union" of Russia should be connected to further develop friendly and cooperative relations with neighboring countries.

(3) For cities that are mainly constrained by the strength of links, such as Heihe, Mudanjiang and Jixi, which are subject to the objective law of geographical distance and the decay of inter-city links, the negative impact can be mitigated by building high-speed railways, linking up with the road networks of neighboring countries and developing air transport.

In addition, the administrative area of Northeast China border cities is large, the natural geographical environment, social population, and economic conditions are complex, and data acquisition is inconvenient. Further research should be conducted using technology, government support, field research, interviews, and other means in order to verify the findings of this study.

7. Conclusions

Based on the analysis of the definition and characteristics of resilience in border cities and the empirical study of Northeast China, this study draws the following conclusions:

(1) Overall, the resilience index of the northeastern border cities from 2010 to 2019 showed a larger increase in the early stage and a slower increase in the later stage, and the spatial differences between cities gradually expanded. In summary, the number of high-level resilient cities has increased in the past 10 years, but they still do not hold a dominant position. Simultaneously, the resilience level of some cities has declined, and two high-resilience core areas have been formed: Hulunbeir and Heihe in the western region, and Yanbian, Mudanjiang, and Jixi in the eastern region. Urban resilience on both sides of the periphery of the core area is low, and there was a trend observed in the space that generally showed a cross-distribution of cities with high, medium, and low resilience levels.

(2) Based on the resilience dimension of the border cities constructed in this study, in terms of the basic resilience level of cities, the polarization pattern of “low in the west and high in the east” has shown an overall improvement and has narrowed with regard to regional differences in the past 10 years. At the level of urban exclusive resilience, overall, resilience has effectively improved over time, although the spatial difference is still large. Among them, Heihe, Mudanjiang, and Yanbian have a good foundation for foreign cooperation, and Hulunbeir and Jixi, with rapid economic growth, have significantly improved resilience.

(3) Through the diagnosis of obstacle factors, it is found that the resilience level of cities in the northeast border is mainly affected by the comprehensive constraints of economic structure, urban scale, and development potential in the basic resilience dimension of cities, and by those of national policy support and the development level of neighboring countries in the exclusive resilience dimension of urban borders. Factors such as the urban infrastructure level, ecological environment, and foreign trade dependence do not have a significant impact.

To enhance the resilience of border cities, on the one hand, it is necessary to regard the basic elements as the basic conditions for urban development, optimize the industrial structure, attract population to enhance the development potential, and protect the lives of residents in order to realize the long-term promotion of the basic strength of border cities and provide support for urban foreign economic activities. On the other hand, highlighting the level of exclusive resilience and its improvement depends more upon the city’s opening-up capacity, including the attraction of policies, and it less limited by factors related to the environment and the contact strength with neighboring countries.

Author Contributions: Software, Visualization, Data curation, K.J.; Visualization, Data curation, K.L.; Formal analysis, Methodology, Project administration, N.C.; Funding acquisition, Conceptualization, Investigation, Supervision, Writing—review and editing, F.P.; Conceptualization, Methodology, Validation, Formal analysis, Data curation, S.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the General Project of the National Natural Science Foundation of China, grant number 42271253 and the Major Special Project of the National Social Science Foundation of China, grant number 20VHQ002.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Ramasamy, B.; Yeung, M.C.H. China’s one belt one road initiative: The impact of trade facilitation versus physical infrastructure on exports. *World Econ.* **2019**, *42*, 1673–1694. [\[CrossRef\]](#)
2. Gu, X.; Womack, B. Border Cooperation between China and Vietnam in the 1990s. *Asian Surv.* **2000**, *40*, 1042–1058. [\[CrossRef\]](#)
3. You, Z.; Yang, H.; Fu, M. Settlement intention characteristics and determinants in floating populations in Chinese border cities. *Sustain. Cities Soc.* **2018**, *39*, 476–486. [\[CrossRef\]](#)
4. Wang, J.; Cheng, Y.; Mo, H. The Spatio-Temporal Distribution and Development Modes of Border Ports in China. *Sustainability* **2014**, *6*, 7089–7106. [\[CrossRef\]](#)
5. Hansen, N. Border regions: A critique of spatial theory and a European case study. *Ann. Reg. Sci.* **1977**, *11*, 1–14. [\[CrossRef\]](#)
6. Zhang, X. Broadband and economic growth in China: An empirical study during the COVID-19 pandemic period. *Telemat. Inform.* **2021**, *58*, 101533. [\[CrossRef\]](#) [\[PubMed\]](#)
7. Geelhoedt, F.; Royuela, V.; Castells-Quintana, D. Inequality and Employment Resilience: An Analysis of Spanish Municipalities during the Great Recession. *Int. Reg. Sci. Rev.* **2021**, *44*, 113–141. [\[CrossRef\]](#)
8. Spaans, M.; Waterhout, B. Building up resilience in cities worldwide—Rotterdam as participant in the 100 Resilient Cities Programme. *Cities* **2017**, *61*, 109–116. [\[CrossRef\]](#)
9. Liu, Y. Optimizing Ideas and Institutional Innovations for Urban–Rural Transformation in China. In *Urban-Rural Transformation Geography*; Springer: Singapore, 2021; pp. 329–364. [\[CrossRef\]](#)
10. Jha, A.; Miner, T.; Stanton-Geddes, Z. *Building Urban Resilience: Principles, Tools, and Practice*; World Bank Publications: Washington, DC, USA, 2013.

11. Hudec, O.; Reggiani, A.; Šiserová, M. Resilience capacity and vulnerability: A joint analysis with reference to Slovak urban districts. *Cities* **2018**, *73*, 24–35. [CrossRef]
12. Sherrieb, K.; Norris, F.H.; Galea, S. Measuring Capacities for Community Resilience. *Soc. Indic. Res.* **2010**, *99*, 227–247. [CrossRef]
13. Huang, G.; Li, D.; Zhu, X.; Zhu, J. Influencing factors and their influencing mechanisms on urban resilience in China. *Sustain. Cities Soc.* **2021**, *74*, 103210. [CrossRef]
14. Zheng, Y.; Xie, X.-L.; Lin, C.-Z.; Wang, M.; He, X.-J. Development as adaptation: Framing and measuring urban resilience in Beijing. *Adv. Clim. Chang. Res.* **2018**, *9*, 234–242. [CrossRef]
15. Chen, X.; Quan, R. A spatiotemporal analysis of urban resilience to the COVID-19 pandemic in the Yangtze River Delta. *Nat. Hazards* **2021**, *106*, 829–854. [CrossRef] [PubMed]
16. You, X.; Sun, Y.; Liu, J. Evolution and analysis of urban resilience and its influencing factors: A case study of Jiangsu Province, China. *Nat. Hazards* **2022**, *113*, 1751–1782. [CrossRef]
17. Chen, Y.; Su, X.; Zhou, Q. Study on the Spatiotemporal Evolution and Influencing Factors of Urban Resilience in the Yellow River Basin. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10231. [CrossRef] [PubMed]
18. Vale, L.J. The politics of resilient cities: Whose resilience and whose city? *Build. Res. Inf.* **2014**, *42*, 191–201. [CrossRef]
19. Tan, J.; Zhang, P.; Lo, K.; Li, J.; Liu, S. Conceptualizing and measuring economic resilience of resource-based cities: Case study of Northeast China. *Chin. Geogr. Sci.* **2017**, *27*, 471–481. [CrossRef]
20. Erdmenger, E. Community Resilience in Urban Tourist Destinations: How Beer Garden Romance and a Hygge Localhood Boost Social Capital. *Z. Tour.* **2019**, *11*, 437–450. [CrossRef]
21. Wang, S.; Cui, Z.; Lin, J.; Xie, J.; Su, K. The coupling relationship between urbanization and ecological resilience in the Pearl River Delta. *J. Geogr. Sci.* **2022**, *32*, 44–64. [CrossRef]
22. Irin News. Humanitarian Concerns Growing Near Iraqi-Turkish Border. Available online: <http://www.politicalaffairs.net/humanitarian-concerns-growing-near-iraqi-turkish-border/> (accessed on 2 April 2023).
23. Zandi, F. Sociological study of social problems of Afghan refugees in yasooj city in 2015. *J. Soc. Sci. Humanit. Res.* **2016**, *4*, 65–70. Available online: <https://journals.researchub.org/index.php/jsshr/article/view/451> (accessed on 2 April 2023).
24. Esfahani, A.N.; Hosseini, S.H. Afghan Refugees and Iran's Open Door Policy in the 1980s. *Pertanika J. Soc. Sci.* **2018**, *26*, 235–252.
25. Shirk, D.A. *The Drug War in Mexico: Confronting a Shared Threat*; Council on Foreign Relations, Center for Preventive Action: New York, NY, USA, 2011.
26. Liebig, B.G. Tajikistan civil war shows folly of geopolitics. *Exec. Intell. Rev.* **1993**, *20*, 52–56.
27. Castanho, R.A.; Loures, L.; Cabezas, J.; Fernández-Pozo, L. Cross-Border Cooperation (CBC) in Southern Europe—An Iberian Case Study. The Eurocity Elvas-Badajoz. *Sustainability* **2017**, *9*, 360. [CrossRef]
28. Chen, Y.W.; Ding, G.L. Measuring the economic resilience of prefecture-level cities in China. *Stat. Decis.* **2020**, *36*, 102–105. [CrossRef]
29. Bai, L.M.; Xiu, C.L.; Feng, X.H.; Mei, D.W.; Wei, Y. Comprehensive assessment of urban resilience in China and its spatial and temporal variation characteristics. *World Reg. Stud.* **2019**, *28*, 77–87. [CrossRef]
30. Du, M.; Zhang, X.; Wang, Y.; Tao, L.; Li, H. An operationalizing model for measuring urban resilience on land expansion. *Habitat Int.* **2020**, *102*, 102206. [CrossRef]
31. Guo, H.; Minier, J. Borders, Geography, and Economic Activity: The Case of China. *Reg. Sci. Urban Econ.* **2021**, *90*, 103700. [CrossRef]
32. Van Houtum, H.; Van Naerssen, T. Bordering, Ordering and Othering. *Tijdschr. Econ. Soc. Geogr.* **2002**, *93*, 125–136. [CrossRef]
33. Feng, X.; Tang, Y.; Bi, M.; Xiao, Z.; Zhong, Y. Analysis of Urban Resilience in Water Network Cities Based on Scale-Density-Morphology-Function (SDMF) Framework: A Case Study of Nanchang City, China. *Land* **2022**, *11*, 898. [CrossRef]
34. Zhao, R.; Fang, C.; Liu, J.; Zhang, L. The evaluation and obstacle analysis of urban resilience from the multidimensional perspective in Chinese cities. *Sustain. Cities Soc.* **2022**, *86*, 104160. [CrossRef]
35. Song, T.; Cheng, Y.; Liu, W.; Liu, H. Spatial difference and mechanisms of influence of geo-economy in the border areas of China. *J. Geogr. Sci.* **2017**, *27*, 1463–1480. [CrossRef]
36. Sekhar, C.S.C. Fragile states: The role of social, political, and economic factors. *J. Dev. Soc.* **2010**, *26*, 263–293. [CrossRef]
37. Noorbakhsh, F. A Modified Human Development Index. *World Dev.* **1998**, *26*, 517–528. [CrossRef]
38. Li, X.; Wang, K.; Liu, L.; Xin, J.; Yang, H.; Gao, C. Application of the Entropy Weight and TOPSIS Method in Safety Evaluation of Coal Mines. *Procedia Eng.* **2011**, *26*, 2085–2091. [CrossRef]
39. Sun, X.; Zhou, Z.; Wang, Y. Water resource carrying capacity and obstacle factors in the Yellow River basin based on the RBF neural network model. *Environ. Sci. Pollut. Res.* **2022**, *30*, 22743–22759. [CrossRef] [PubMed]
40. Sun, C.Z.; Wang, Z.Y.; Li, B.; Gai, M.; Ke, L.N. *Basic Theory and Empirical Research on The Sustainable Development of China's Marine Economy*; Science Press: Alexandria, Australia, 2022.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.